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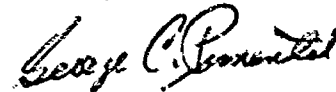
FINAL REPORT

DOD-University Research Instrumentation Program Grant AFOSR-87-0044

TRANSIENT BEHAVIORS IN CHEMICAL REACTIONS: NANOSECOND INFRARED

SPECTROSCOPY, CHEMICALLY PUMPED VISIBLE AND NEAR-IR LASERS.

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The purpose of this grant was to provide funds for acquisition of an excimer dye laser to serve as a dedicated photolysis source to accompany our nanosecond infrared spectrometer. This nanosecond infrared spectrometer provides a broad-band ($\sim 300 \text{ cm}^{-1}$ band width) continuum infrared pulse near ten microns with pulse duration near one nanosecond. This pulse can be used as a diagnostic "probe" pulse to investigate transient molecular species with lifetimes as short as ten nanoseconds. The requested photolysis source produces the transient species we wish to study.

The funds have now been expended in the purchase of a Lambda Physik Model EMG 201 Excimer Laser with pulse duration of 28 nanoseconds (FWHM) and average power at 248 nm of 530 millijoules per pulse. It has been in successful operation now for several months. Figure 1 shows an example of its successful use. The sample photolyzed was a mixture of 0.5 torr CF_3I plus 25 torr of CO_2 in a one meter path cell. The photolysis source was operated at 248 nm to photodissociate a fraction of the CF_3I , producing gaseous CF_3 and I. With selected delay times, the IR probe pulse was used to examine the infrared spectrum of CF_3 in the spectral region centered around 1250 cm^{-1} . The figure shows that at modest delay times (1-5 microseconds), the CF_3 spectrum has the classic P-R band contour of a rotationally and vibrationally relaxed molecule. At much longer times, this CF_3 signal disappears due to the (relatively) slow binary recombination to form C_2F_6 , which is recorded as a final, stable product. What is most interesting in this study is the spectrum after short delays (less than 200 nsec).

The CF_3 spectrum plainly shows the presence of a high concentration of



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vibrationally excited molecules. The temporal changes between 10 and 1000 nanoseconds permit direct measurement of vibrational relaxation. In addition, enhanced reactivity of such vibrationally excited molecules with some added reactant can be sensed and measured.

This is but one example showing the successful and productive outcome of this grant. Publications are in preparation; all equipment details are included in the Ph.D. dissertation of Mark Young, University of California, Berkeley, California (December 1987).

Figure 1

CFI .5 bar

